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ENEE 303H Final Exam – Fall 2016

150 points, 2 hours, open book, open notes. Notebooks are due with the exam.

Good luck and have a good semester break

Of use may be that the s-domain operation on the unit step function 1(t) is 1/s and on $e^{at}1(t)$ is 1/(s-a)

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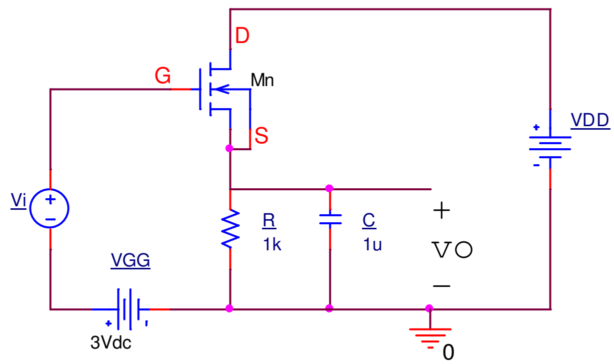
1. (60 points, 40 minutes)

For the circuit of this problem assume that Cgs=Cgd=0 and when in saturation the transistor is described by

$$I_D = k(V_{GS}\text{-}VTO)^2(1+\lambda V_{DS})$$

The turn-on voltage is VTO = 1V; VDD=6V, VGG=3V. vi is a small signal voltage source input while R=1KΩ and C=1μFd. The Q point drain current value is I_D=1mA



a) Find the Q point values of V_{GS} and V_{DS}; verify that the transistor is in saturation.

b) If λ=0.1 give the value of k.

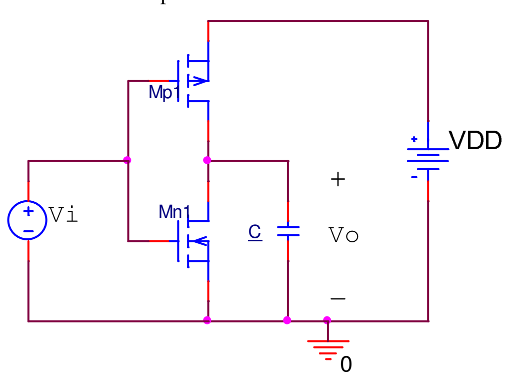
c) Give the value of g_m and g_o of the transistor at the Q point.

d) Draw the small signal equivalent circuit.

e) Give the small signal voltage transfer function T(s)=vo/vi.

2. (60 points, 40 minutes)

For the following circuit, assume Mp and Mn are fully complementary with $k=10^{-6}$, C=1uFd, VDD=6V and VTO_p=-Vdd/6. Also assume λ, Cgs, and Cgd all zero, as well.

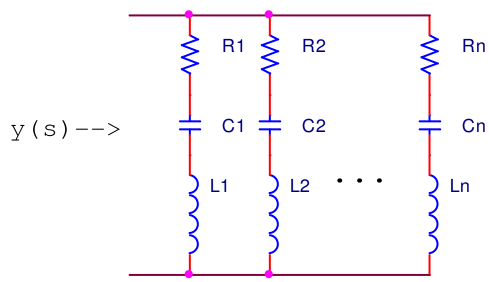


a) If, at t=0-, vo=vi=VDD/2, and then the input changes to vi(t)=0 for 0<t show that for 0<t Mp will be in the Ohmic state and give the state of Mn.

b) Set up the differential equation for x(t)=VDD-vo(t) for 0<t

c) Give the time t_5 at which $vo(t_5)$=5.

3. (30 points, 20 minutes)



For this circuit where n is a positive integer and all element values are non-negative:

a) Give the input admittance y(s) and its poles along with one of its zeros.

b) For n=2 and R1=R2=0, L1=L2=1 and 4C2=C1=1, give the current response to a unit step function of voltage when all initial conditions (at t=0-) are zero.